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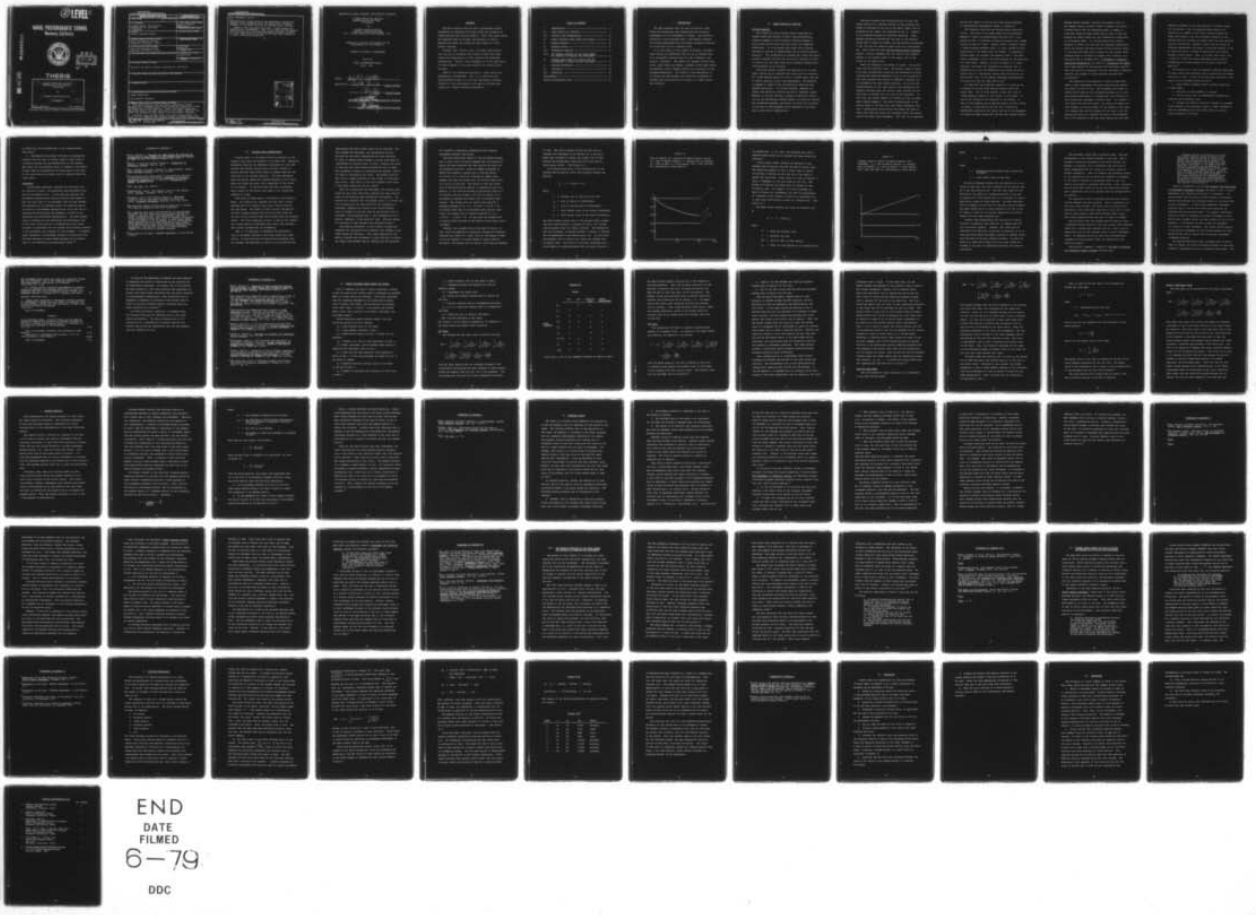

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Based on the literature available, a lease versus buy methodology is determined. Also, it is shown how this method should be part of a one step cost-benefit analysis instead of a two step method to be used by the Army when leasing is a viable financing alternative.

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A Lease Versus Buy Decision Methodology for the Army: A Proposal

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Submitted in partial fulfillment of the requirements for the degree of

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ABSTRACT

The Army currently does not have a prescribed uniform methodology to determine the lease versus buy financing of items procured from private industry. Also, when lease versus buy decisions have to be made, the decision is often a separate one after the system has been chosen by a cost-benefit analysis.

Discount rate, salvage value, tax rates, depreciation, and risk are all elements that directly affect the lease versus buy determination in both industry and government transactions. However, total agreement as to the application of these elements to the final decision is lacking within the Army.

Based on the literature available, a lease versus buy methodology is determined. Also, it is shown how this method should be part of a one step cost-benefit analysis instead of a two step method to be used by the Army when leasing is a viable financing alternative.

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I. INTRODUCTION

The Army currently does not have an explicit lease versus buy methodology when establishing the financial arrangements in the procurement of assets. The method of financing is often decided after a cost-benefit analysis has already determined which of several candidate items are to be procured to fill a specific need.

It is the intent of this thesis to propose a workable lease versus buy methodology that can be an inherent part of a cost-benefit analysis and not just a separate, and partial, evaluation. The thesis will examine current practices, lease versus buy models, elements of the lease versus buy decision, and an example showing the attributes of the proposed methodology. The purpose of the methodology is to provide the Army manager with objective guidelines to maximize the utilization of his budget in a lease versus buy situation.

II. LEASE VERSUS BUY OVERVIEW

Private Industry

Wall Street is giving leasing firms a good deal of respect these days because of their high profitability. A popular example is the automobile leasing business in which firms such as Hertz and Avis rental car companies predominate. It is estimated that these firm's leasing business is growing at approximately ten to fifteen percent annually.[1] Itel Corporation is another well known firm which recently reported raising over one billion dollars of credit in order to buy and then lease heavy equipment ranging from containerships to jet aircraft.

Long term leasing, normally for periods of two or more years, should not be confused with rental which is normally for a much shorter period of time at a higher daily rate and is used to satisfy a short term requirement. The question of whether to lease or buy any particular asset has been debated continually. In private industry, leasing is a widely used method of securing the use of important assets. However, in private industry, leasing is made more attractive by tax differences between leasing (in which all outlays are considered expenses) and owning (in which only a portion of the cost of the equipment can be expensed in any given year in the form of depreciation).

From the financial and accounting point of view, the unique feature of a leasing contract is that although the lessee is entitled to the use of the asset, legal title is retained by the lessor, who continues to own it. Leasing is an alternative method of financing ownership. Under present accounting conventions, the user of the property cannot show it among his assets, and the periodic obligations to pay rent are not shown as liabilities until they become due. Thus arises the term off-the-balance-sheet financing. However, one must remember that the value of the property appears on the balance sheet of the lessor, who is the holder of the legal title.

There are basically two classes of leases - the service lease and the financial lease. The service lease or operating lease includes both financing and maintenance services. International Business Machines is one of the initiators of this type contract with regard to computers, together with the automobile and truck rental agencies. One of the two characteristics of this type lease is that frequently the payments required under the initial lease contract are not sufficient to recover the full cost of the equipment. In this case, the lessor expects to recover his cost in subsequent renewal payments. The other characteristic of the service lease is the fact that such leases frequently contain a cancellation clause giving the lessee the right to cancel the lease and return the equipment before the expiration of the basic lease agreement. This fact is an important

one for the lessee in that he can return lease equipment if technological developments render it obsolete.[2]

The financial lease has two distinguishing characteristics. The first is the fixed nature of the obligation. Whenever a lease is noncancellable and runs over a long period of time, it produces a financial burden on the lessee similar to that of a debt. Second, under a financial lease, a lessee promises payments which, in total, exceed the purchase price of the assets that are leased. In analyzing a balance sheet, we consider the payments under a long-term lease arrangement to be in the same category as the servicing of a bond issue. However, in case of default of a lease contract, the lessor may repossess his property, but in bankruptcy his claim for damages may not exceed one year's future rent if a liquidation results from the failure, or three years' rent if the company undergoes reorganization, no matter how long the lease had to run.[3]

In some cases the borrowing capacity of a firm can be increased by raising funds through leases rather than direct debt. One of these factors is that the title to leased property remains in the control of the lessor. It can not be touched by the creditors of the lessee. In fact if the property can be expected always to have a value to others, a lease may be the only way a financially embarrassed corporation can obtain the use of new equipment. It should be noted though that the more the leased property

becomes special purpose, the more the general credit of the company limits its power either to lease or to borrow. A second factor that may sometimes permit a company to raise more funds by lease rather than by debt is that the burdens the lease creates are not evidenced by liabilities on the balance sheet. The results may be that certain grantors of credit will not take the leasehold obligations fully into account and thus be more willing to grant credit if the equivalent debt were to appear on the balance sheet. Although there is evidence to support this situation, the FASB published in November 1976 in Statement of Financial Accounting Standards No. 13 (SFAS 13): Accounting for Leases that leases should not be excluded from disclosure requirements and should be consistent with the information presently required with respect to owned property and long-term obligations.[4]

The reduction of tax payments is often a reason that makes a lease arrangement desirable from both the lessee's and lessor's point of view. The investment tax credit in effect can be used for tax avoidance purposes and to limit the maximum percentage of a corporation's tax liability if that corporation purchases a capital asset. If, however, a firm cannot use this tax credit, the leasing of assets can then transfer an outlay subject to tax credits to the books of a company that has not reached its tax limit, with the parties splitting the lump-sum tax loss to the government. Not to be forgotten is the fact that leasing can also make

offsetting changes in the time profiles of taxable income for the parties. This circumstance made leasing very attractive to leasees in the 1930's largely because the lease would permit a far more favorable schedule of tax shields than was available to owners under the then existing laws and regulations. However, today, with the advent of different depreciable life spans, a firm that desires to own an asset may select a scheme of depreciation with heavy charges in early years. Thus, it is much less likely that a lease will offer tax shield advantages solely without consideration of other aspects of the lease versus buy decision.[5]

The following is a list of generally accepted advantages of lease rather than ownership from an operations and budgeting point of view. As will be obvious upon inspection, most apply to the government sector as well.[6]

a. Fixed monthly payments permit accurate prediction of cash needs.

b. Typically no down payment is required.

c. Unlike a bank loan, no compensating balances are required thus conserving cash.

d. Because the lessor's financial interest is presumed to be secured by the equipment itself, a lease transaction does not necessarily give the lessor power to restrict other financing by the firm.

e. Because leases are treated as operating, rather than capital, expenses, middle managers with some discretion about expenses can make lease deals rapidly without needing the approval of corporate headquarters.

f. Because the capital appropriations process is so complex in many big companies and in government, especially in the middle of a year, unplanned purchasing is very difficult. Leasing cuts through this problem.

g. If the government begins a tight money policy, a company can negotiate leases instead of debt financing although this move may be a destabilizing influence in regard to government aims.

In an evaluation of the lease versus buy decision, firms must also take into account the important yet vague areas of risk, discount rate, method of lease versus buy evaluation, and salvage value in order to conclude a rational decision. A detailed discussion of these areas, both theoretical and practical, will follow in succeeding chapters.

Surveys of the leasing industry indicate a wide divergence of practices. This circumstance is a probable consequence of the fact that the field of finance has not yet developed a consensus in regards to a lease versus purchase model. For example, Sorensen and Johnson conducted a survey of some 520 retail financial lease contracts from four non-bank retail firms. These contracts on different categories of equipment were studied and descriptive material relating

to asset costs, asset types, maturities, prepayments, collateral, default remedies, and treatment of the investment tax credit were generated. The following conclusions were reached.[7]

a. Financial leases take advantage of the liquidity of funds invested in easily traded equipment, and transfer the uncertainty over residual values to those best informed about resale markets.

b. Lessors reduce the weight of their risk-bearing functions by diversifying across equipment types, customers, and regions.

c. Profitable trade between firms in the leasing contract seems to be due only in a small part to reduced tax payments.[8]

d. Firms have been able to set prices on the basis of high target rates of return. However, there is strong evidence of competitive erosion because of recent changes in accounting practices and rebates to equipment manufacturers. This survey on costs quoted implied cost rates averaging 24.98 and 18.69 percent on before and after tax (50 percent) basis respectively on contracts no larger than $200,000.

e. In larger firms, this survey indicated that although multiple hurdle rates were used to adjust for risk differentials among projects in capital budgeting programs, few respondents to the survey employ lease models which attempt

to adjust for risk differentials in the lease-purchase cash flows.[9]

f. Implementation problems involving the appropriate discount rate for each of several types of cash flows in a decision process and the determination of the optimal debt level for the purchase option in regards to the amount of debt capacity displaced by the lease seem to bias many of the lease versus buy models used by industry toward the lease option.

Government

In government budgeting, managers are concerned with two sources of funds - the operations and maintenance fund and the procurement fund. In the Army the operation and maintenance appropriation funding structure has tended to mask the total cost of the equipment from the army manager. The purchase cost of equipment under the ownership option is borne by a procurement appropriation, while the cost of operating and maintaining the equipment is borne by the operations and maintenance appropriation. The army manager tends to address only the operations and maintenance side of the cost picture and not to consider the initial costs incurred in procurement nor the salvage value dollars returned to the government upon disposal of the equipment. In essence sharp reductions in procurement funding in recent years has led army managers to lease needed equipment by allocating costs to the operations and maintenance funds.[10]

FOOTNOTES TO CHAPTER II

[1]Karne, Michael R., Analysis of Lease Versus Buy Options for Procurement of Radio Assets for the Marine Corps Air Station at Yuma, Arizona, NPS Masters Thesis, 1977, p. 8.

[2]Weston, J. Fred and Brigham, Eugene F., Essentials of Managerial Finance, 1968, p. 265.

[3]Hunt, Pearson, Williams, Charles M., and Donaldson, Gordon, Basic Business Finance, 1971, pp. 421-425.

[4]The Accounting Principles Board of the American Institute of Certified Public Accountants, Statement of Financial Accounting Standards No. 13 (SFAS 13): Accounting for Leases, (November 1976).

[5]Hunt, Op. Cit., pp. 426-427.

[6]Vanderwicken, Peter, "The Powerful Logic of the Leasing Boom", Fortune, (November, 1973), p. 132.

[7]Sorensen, Ivar W. and Johnson, Ramon E., "Equipment Financial Leasing Practices and Costs: An Empirical Study", Financial Management (Spring, 1977), pp. 33-40.

[8]The Anaconda Company leasing case as explained in chapter VIII does not reconcile with this conclusion.

[9]For companies that use a rate-of-return of time-adjusted analysis, the risk dimension usually enters through the hurdle or discount rate. Most businesses today use a single corporate hurdle rate, which is generally considered to be the company's cost of capital or some higher target chosen arbitrarily as an attainable level of profitability. Some companies carry the risk analysis one step further by having multiple hurdle rates reflecting different risk categories. One way this is done in a multi-division company is by division or product grouping.

[10]Department of the Army, "FORSCOM Supplement 1 to AR 340-20", p. A-1.

III. DISCOUNT RATE DETERMINATION

A major factor in the lease versus buy decision is the timing of the costs and benefits in the cash flow. Typically, purchasing requires the immediate incurrence of a one time initial cost whereas leasing would involve a series of smaller periodic costs which would be greater than the one-time cost of the purchase decision. The time difference cannot be merely summed and compared because to do so would imply that money has equal value regardless of the timing of its receipt. If the above were the case, purchasing would clearly be the choice over lease in all situations, assuming no taxes.

Time value of money makes a difference to the decision maker. An investor will consider the fact that a dollar received now is of greater value than a dollar received one year hence. The reason is that a dollar received now can earn interest whereby that dollar one year from now is worth to the investor some value greater than our original dollar. With this reasoning in mind, it may be that leasing can in some cases be considered less costly than purchase, even without differential tax treatments.

Thus, it is important to determine the opportunity cost of the money involved in the lease versus buy transaction. In each decision the analyst must determine both the category and magnitude of costs to be incurred and the

time period over which those costs will be incurred. Two cost streams are developed, one representing the buy decision and the other representing the lease decision. In order to compare these streams, a single value must be ascertained at a certain point in time - usually that point in time that the lease versus buy decision will be made. This procedure is known as calculating the present value of the costs or discounting the costs. The present value of each cost is summed according to the stream in which that cost occurs. The result is the total present value costs of the lease stream and the buy stream.

When the calculations are performed, the discount rate should be that value which best reflects the time value of money of the decision maker performing the analysis. The results will indicate that the present value of a future cost will be smaller as the time period of the investment is increased, assuming the discount rate is held constant. Also of interest is the fact that as the discount rate is increased, the discounted cost of the investment will be smaller, assuming a fixed period of time. Discount tables are available in most economic and accounting texts.[1]

The previous discussion is only a basic illustrative framework for calculating the necessary cost streams in the lease versus buy decisions. The actual opportunity cost used by industry and government is more difficult to obtain. Two widely used methods used by industry are now described

as a preface to eventually determining more adequate government discount rate policy.

The more traditional theory of the two methods states that a firm's cost of capital depends upon the mixture of equity and debt financing the firm uses as the basis for its financial policies. Using an example presented in Dopuch and Birnberg, suppose that a firm has assets of $10,000, all of which are financed by common stock. Suppose also that the assets earn 10% and the stock sells at a price to yield 10%. The result is that the direct cost of obtaining equity capital is measured by this 10%. However, if the firm now borrows an additional $5000 at a 4% interest rate but yields a 10% rate of return, 4% is considered to measure the direct cost of obtaining debt capital. The average cost of capital then would be a weighted averaged of 8%, i.e., 2/3(10%) + 1/3(4%) = 8%. If another $5000 were to be borrowed under similar conditions, the average cost of capital would be 7%, i.e., 1/2(10%) + 1/2(4%) = 7%. In this case the average cost of capital would decrease as the debt-to-stock equity ratio increases.

However, the interest rate or the rate on equity, or both, would be expected to eventually increase as investors realized that there is a "safe" limit on the amount of debt a firm can support on a given amount of equity capital. Obviously, the average cost of capital would then be expected

to rise. The rate on equity capital and the rate on interest are considered to be constant up to the point where they increase to reflect the higher risk to bond holders and stockholders associated with high debt-to-stock equity ratios. (See figure 3-1.)

At an equilibrium point or the minimum point on the average cost-of-capital curve, the following formula was derived:

$$i_e = P + (B/S)(P - r_b)$$

where

P = average cost of capital to the firm.

i_e = rate of return to stockholders.

r_b = rate of interest paid to bondholders.

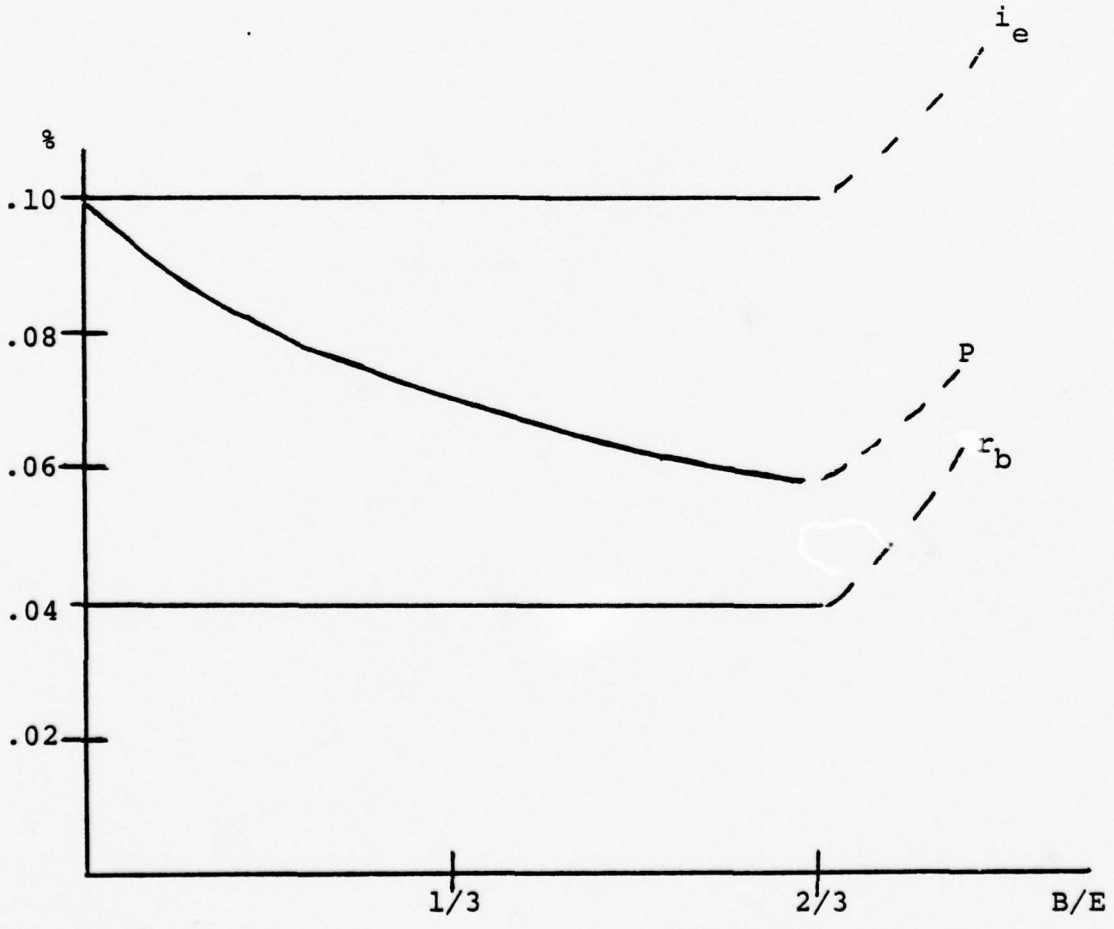
S = total market value of the stocks outstanding.

B = total market value of the bonds outstanding.

The above formula states that if the decision maker assumes that the firm maintains a constant B/S ratio, the average cost-of-capital rate will remain constant. The assumptions here are no-growth, a constant pattern of assets, a constant set of preferences in the market place, etc. At this point the marginal cost of capital will equal the average cost-of-capital rate. The firm will then make investment decisions based on a balance between debt and equity capital in

Figure 3-1

Cost of capital as a function of debt-to-equity ratios. i_e = rate on equity capital; P = average cost of capital; r_b = rate on debt; E = stock equity; B/E = long term debt as a percentage of stock equity.[2]



an optimal mix. It is, then, this discount rate that a decision maker would use to evaluate his lease versus buy decision.[2]

A more recent theory concerns the behavior of the average cost of capital rate and the rate on equity stock. The underlying premise is that a firm's cost of capital is strictly a function of the risk due to the types of assets the firm holds. Thus, there is a cost of capital, P, which is dependent on the risk class of the firm. The method of financing the assets does not change the cost of capital rate. For example, if a firm increases its debt to finance its investments, the risk to stockholders is increased in that holding a stock of an unlevered firm is less risky than holding a stock of a levered firm. (See figure 3-2.)

The newer theory measures the after tax discount rate as

$$P^* = (1 - t(B/V))P_t$$

where

P^* = after tax discount rate.

t = marginal tax rate.

B/V = ratio of debt to total equity.

P_t = after tax rate applied to an unlevered firm.

Figure 3-2

Constant costs of capital as debt-to-equity (B/E) increases. i_e = rate on equity capital; P = average cost of capital; r_b = rate on debt; E = stock equity; B/E = long term debt as a percentage of stock equity.[3]

Where

$$P_t = (X/V)(1 - t)$$

where

X = expected average earnings from a given set of assets.

V = total market value of the firm.

The main difference between the two theories is in the effect of debt upon the firm's average cost of capital rate up to the equilibrium point. The fact that there are two theories on the effect of financing policies on the cost of capital of a firm implies that it is difficult to verify empirically either of these theories. The most favorable one will probably be the one with the most intuitive appeal. The newer theory which is often referred to as the "M and M" theory in honor of its authors, Modigliani and Miller, seems to be the widely accepted one.[3]

Discount rate determination for evaluation of public projects is generally more difficult to compute than the one for private industry. However, this chore must be performed if an efficient allocation of resources is to be realized either among government projects or between government projects and private industry projects. To make any sense of a model which helps solve the lease versus buy dilemma in the Army, an appropriate discount rate must be calculated.

The government issues debt in several forms. The most recognizable to the average consumer is the bond. When a consumer voluntarily purchases a bond which returns, for example, six percent, he is indicating that this rate of return compensates him for giving up a dollar's worth of present consumption. Thus, an observer can determine bounds on the opportunity cost by noting the consumer's acceptance of the rate of interest on government bonds by that consumer's willingness to purchase those bonds. Also, logically, one can state that those who do not own bonds must consider their opportunity cost to be greater than the aforementioned six percent.

The opportunity cost of resources derived from industry follows somewhat the same argument. With a corporation tax rate near fifty percent, low profit ceiling utilities are expected by their regulatory agencies to yield five to eight percent after taxes or some twelve percent before taxes. Most other industries must earn more in order to prosper.

The conclusion that one reaches from the above is that a proposed discount rate must take into account that resources taken from a bondholding consumer have as a lower range an opportunity cost of the interest rate on current government bonds. On resources which are kept from non-bondholding consumers or from business firms, the opportunity cost should be higher.[4]

Specifically, Raymond F. Mikesell's The Rate of Discount for Evaluating Public Projects believes that

> Although the rate of discount for evaluating public projects should be based on the opportunity cost of capital in the private sector, the comparable rate of return in the private sector should be the before-tax rate of return on projects in the same risk class. There may, of course, be no category of private investment comparable to certain types of investment in the public sector. In this case, the best approach might be to employ the rate of interest on long-term government securities adjusted for the corporate income tax, plus an allowance for risk determined on the basis of probability coefficients for benefits and costs appropriate to the particular project to be evaluted.[5]

Jacob A. Stockfisch's article The Interest Rate Applicable to Government Investment Projects estimated a rate of return measured on the "marginal efficiency of investment". He also believes that the rate of return should be calculated before taxes because the government shares in the yield from private investment. In particular government investment projects cause a loss of tax yields when resources are diverted from the private sector. For example, Stockfisch points out that an increment of private investment of $100 million may increase the net national product by $15 million annually. A 50 percent tax rate yields the government $7.5 million of that increment. The overall social benefit of the private investment is thus fifteen percent and thus should be the rate of return used to evaluate government investment projects.

The implied equilibrium from a standard rate of return does, of course, not exist principally because of individual investor's perception of risk on different type assets. The

government, thus, is forced to use some average of marginal rates of return in order to obtain an overall measure of the social benefits of private investment. Stockfisch confronted this problem by noting the average rate of return in manufacturing industries to be approximately fifteen percent and the rate of return in the regulated industries to be approximately ten percent. This survey was valid for the period 1951-65. He thus concluded that these rates appeared to be reasonable estimates of the opportunity cost of private investment in those sectors. He further weighted the flows of capital from the two sectors at 70 percent and 30 percent respectively. The weighted average yielded a 13.5 percent overall rate of return. This overall rate, he argued, would be an acceptable discount rate for government projects.[6]

Elmer B. Staats, Comptroller General of the United States in 1968, presented a different method from the previous ones in calculating a discount rate in a Report to the Joint Economic Committee, U.S. Congress, January 29, 1968. He stated that if Treasury borrowing costs are calculated on the basis of total costs to the government, including corporate and individual income taxes foregone as a result of borrowing by the government to finance programs, an estimate of between seven and eight percent would result. Remembering the time frame of the report, note his analysis in figure 3-3.[7]

Figure 3-3

Illustration of Calculation of Total Cost to the Government of Borrowed Funds[7]

Method 1

The current interest cost of borrowing long-term money is approximately 5 percent. The moving average rate specified by Senate Document 97 is currently about 3.2 percent. Therefore, a rate of interest approximately halfway between 5.0 and 3.2 percent could be used for initial consideration as the Government cost of borrowed money.*

4.0%

Add to this cost:

1. Corporate taxes foregone by the Government if the average corporate return on investment is 12 percent before taxes, if the fraction of dollars borrowed by the Government which would have gone into corporate investment is 65 percent, and if the marginal corporate tax rate is 40 percent.
(.12)(.65)(.4) 3.1%

2. Personal taxes foregone by the Government if the average return on proprietorship, personal income-producing investments, etc., is such that the remaining 35 percent of money borrowed by the Government would have earned a 10 percent return for the persons taxed and if such a return would be taxed at a composite marginal rate of 30 percent.
(.1)(.35)(.3) 1.0%

3. (a) Taxes foregone by the Government of dividends that would have been received by individuals from corporations if the composite marginal tax rate applicable to individuals is 30 percent, if the taxable dividends payout is 40 percent of corporate earnings and the marginal tax rate shown above under (1) are applicable. The marginal corporate tax rate is assumed to be 40 percent, therefore 60 percent of corporate earnings is assumed available to the corporation for payment of dividends.
(.3)(.4)(.12)(.65)(.6) = .6%

(b) Personal taxes foregone by the Government if the corporate investment is financed by bonds rather than by corporate earnings, if corporate bonds carry an interest rate of 5 percent, if the fraction of dollars borrowed by

* Note that these rates of interest are from 1969 data.

the Government which would have gone into corporate investment is 65 percent, and if the composite marginal tax rate applicable to individuals is 30 percent.
(.05)(.65)(.3) = 1.0%

(c) Actual overall financing arrangements by corporations will generate tax revenues under both (a) and (b), therefore the cost to the Government may be assumed to be somewhere between .6 percent and 1.0 percent, say about .8%

Subtract from this cost:

1. Income taxes collected on Government interest payments, if investments in bonds (see rate above of 4 percent) are divided between corporations and individuals in such a way that the tax rate is 35 percent.
(.04)(.35) -1.4%

Cost to Government 7.5%

Method 2

On an aggregate basis, a similar result may be computed assuming a composite corporate and personal marginal tax rate of 50 percent and a taxable return of 10 percent on any money not borrowed by the Government.
(.5)(.1) 5.0%

Cost of Government borrowing (see explanation under Method 1) 4.0%

Less taxes if Government bond interest (.04)(.35) (see explanation under Method 1) -1.4%

Cost to Government 7.6%

In practice the Department of Defense has been mandated to recognize the timing of cash-flows by the required use of discounting techniques. An overall rate of ten percent has been stated as a rate which reflects the preference for current and future money sacrifices that the public exhibits in non-government transactions. This prescribed rate is supposed to represent an estimate of the average rate of return on private investment before corporate taxes and after adjusting for inflation.[8]

As stated previously, especially in chapter three, the discount rate plays an important role in the lease versus buy decision. The above illustrations as to a calculation of a representative discount rate for the present year yields the observation that the DOD mandated rate may indeed be too low.

FOOTNOTES TO CHAPTER III

[1]Karne, Michael R., Analysis of Lease Versus Buy Options for Procurement of Radio Assets for the Marine Corps Air Station at Yuma, Arizona, NPS Masters Thesis, 1977, pp. 42-45.

[2]This analysis was summarized from an abbreviated review of the section in "The Cost of Debt and Equity Funds", in the The Management of Corporate Capital, Solomon, E., ed., pp. 91-204. The review itself appeared in Cost Accounting, Dopuch, Nicholas and Birnberg, Jacob G., 1969, pp. 192-195.

[3]This analysis was summarized from a section in Cost Accounting, Dopuch, Nicholas and Birnberg, Jacob G., 1969, pp. 195-197. The authors took the equation from F. Modigliani and H. Miller, "Corporate Income Taxes and the Cost of Capital - A Correction", in "Communications", American Economic Review, Vol. LIII, June 1963 pp. 433-43.

[4]Baumol, William, J., "On the Appropriate Discount Rate for Evaluation of Public Projects", Program Budgeting and Benefit-Cost Analysis, Hinrichs, Harley H. and Taylor, Graeme M., ed. 1969, pp. 202-207.

[5]Mikesell, Raumond F., The Rate of Discount for Evaluating Public Projects, 1977, p. 40.

[6]Stockfisch, Jacob A., "The Interest Rate Applicable to Government Investment Projects", Program Budgeting and Benefit-Cost Analysis, Hinrichs, Harley H. and Taylor, Graeme M., ed. 1969, pp. 193-201.

[7]Staats, Elmer B., "Surveying of Use by Federal Agencies of the Discounting Technique in Evaluating Future Programs", Program Budgeting and Benefit-Cost Analysis, Hinrichs, Harley H. and Taylor, Graeme M., ed., 1969, pp. 227-228.

[8]DOD Instruction 7041.3, "Economic Analysis and Program Evaluation for Resource Management", October 18, 1972, encl. 2, pp. 6-7.

IV. WIDELY ACCEPTED LEASE VERSUS BUY MODELS

Paul F. Anderson and John D. Martin conducted a survey of the top Fortune 200 firms in order to determine the methods used in a lease versus buy decision. The survey indicated that the companies depended on the traditional internal rate of return (IRR) model, the conventional net present value (NPV) model, a variant to the Weston and Brigham model (1972), and a variant to the Bower, Herringer, and Williamson model.[1]

Before examining these different models, note the following notation and their meaning.

A_o = cash purchase price of the asset.

R_i = lease payment required in year i.

D_i = depreciation charge for year i allowed for tax purposes.

I_i = interest on a loan or loan equivalent in year i.

I_i'' = Bower, Herringer, and Williamson model method of computing the equivalent loan in year i.

O_i = total pre-tax cash operating costs expected to occur in year i if the firm purchases the asset but not if the asset is leased.

V_n = expected after-tax salvage value of the asset at the end of year n.

L_i = payment of principle and interest on a term loan in year i.

n = useful economic life of the asset in years.

t = corporate average and marginal tax rate on ordinary income.

t_c = investment tax credit rate.

K_t = after tax weighted average cost of capital for the firm.

r = pre-tax interest rate on intermediate-term debt.

$r_t = r(1-t)$, after-tax interest rate on intermediate-term debt.

P_t = after-tax cost of leasing (IRR model).

NAL = the NPV advantage of the lease.

See figure 4-1 for a table of commonality of elements of the lease versus buy models under discussion.

NPV Model

The conventional NPV model can be stated as follows.

$$NAL = \sum_{i=1}^{n} \frac{L_i}{(1+K_i)^i} - \sum_{i=1}^{n} \frac{R_i}{(1+K_t)^i} - \sum_{i=1}^{n} \frac{tD_i}{(1+K_t)^i} + \sum_{i=1}^{n} \frac{tR_i}{(1+K_t)^i}$$

$$- \sum_{i=1}^{n} \frac{tI_i}{(1+K_t)^i} + \sum_{i=1}^{n} \frac{O_i(1-t)}{(1+K_t)^i} - \frac{V_n}{(1+K_t)^n} - \frac{t_c A_o}{1+K_t}$$

From the above observe that an investment proposal's NPV is derived by discounting the cash receipts to their present values and summing them over the life of the proposal. One can assume that the firm will wish to maximize its wealth,

Figure 4-1

MODELS

MODEL ELEMENTS	NPV	IRR	LUMP SUM LOAN	ANNUAL INSTALLMENT
A_o		X	X	
L_i	X			X
R_i	X	X	X	X
tD_i	X	X	X	X
tR_i	X	X	X	X
tI_i	X		X*	X
$O_i(1-t)$	X	X	X	X
V_n	X	X	X	X
$t_c A_o$	X	X	X	X

* Note that I_i and I_i'' are somewhat different as shown on page 3

and there exists perfect certainty as to the elements of the above equation. Then, the decision rules will be that when NPV is greater than zero, we lease the project and when the NPV is less than zero, we buy the project. The present values are calculated using a discount cost which reflects the alternative use of capital, i.e., the opportunity cost which under certainty would be the riskless rate of interest. Thus, these decision rules should, under the assumed conditions, result in an optimal choice of projects that can be found which will increase the value of the firm.

IRR Model

The traditional IRR model is another time-discounted measure of investment worth. As applied to the lease versus buy decision, the equation is as follows.

$$0 = A_o - \sum_{i=1}^{n} \frac{R_i}{(1+P_t)^i} - \sum_{i=1}^{n} \frac{tD_i}{(1+P_t)^i} + \sum_{i=1}^{n} \frac{tR_i}{(1+P_t)^i} + \sum_{i=1}^{n} \frac{O_i(1-t)}{(1+P_t)^i}$$

$$- \frac{V_n}{(1+P_t)^n} - \frac{t_c A_o}{1+P_t}$$

From the above equation, the IRR is defined as that rate of discount which equates the present value of the stream of net receipts with the initial outlay. The decision rules for the IRR model are the following.[2]

a. Lease if the IRR exceeds the after-tax weighted average cost of capital for the firm.

b. Buy if the IRR is less than the after-tax weighted average cost of capital for the firm.

From the above two models, observe that if a buy decision is reached through the NPV criterion, the buy decision will also be reached by the IRR criterion, and vice versa. If the lease versus buy decision is not a separate decision from the decision as to whether to undertake a project, one must examine and evaluate the incremental cash flows at the firm's cost of capital. Then, the NPV method insures that the firm will reach the optimal scale of investment and is established in terms of a percentage rather than in terms of absolute dollars. However, one should be careful to note that despite the fact that both the NPV and IRR models result in the same lease and buy decisions, this equivalence does not necessarily hold for the ranking of investment proposals. This same problem arises in traditional capital budgeting decisions among mutually exclusive choice situations.

Also, assumptions as to reinvestment rates further differentiate between IRR and NPV in the lease versus buy decision. The reinvestment rate is the time-discounting process that underlies both the NPV and IRR methods. In the NPV method it is assumed that all receipts can be reinvested at the firm's opportunity cost of capital or the firm's

alternative use of funds. On the other hand, the IRR method assumes reinvestment at the project's rate of return. This latter assumption, however, has no economic basis since the alternative cost of capital may not be the project's rate of return and the after-tax weighted average cost of capital for the firm at the same time. The first reason the above could not occur is that high-return projects in the future may not be available as they are today. The second reason is that even if such projects were available, these projects will always be executed by a firm whose cost of capital is equal to K_t in the NPV model independent of the decision on the current project under consideration. Thus, it is in error to credit the current project with any future benefits accruing from the reinvestment of the interim proceeds at rates of return above K_t in the NPV model. Therefore, in deciding which lease versus buy model to use, one must remember that the NPV method provides an optimal solution to the generalized capital budgeting problem given the assumption that future cash flows and the appropriate cost of capital are known. Both the NPV and IRR are weighted averages where the former method uses the appropriate short-term weights: K_1, K_2, ..., K_t while the latter method uses the inappropriate long-term rate of return P.[3]

Lump Sum Loan Model

The third method of lease versus buy to be considered is the Lump Sum Loan model.

$$NAL = A_o - \sum_{i=1}^{n} \frac{R_i}{(1+r)^i} - \sum_{i=1}^{n} \frac{tD_i}{(1+K_t)^i} + \sum_{i=1}^{n} \frac{tR_i}{(1+K_t)^i} - \sum_{i=1}^{n} \frac{tI_i''}{(1+K_t)^i}$$

$$+ \sum_{i=1}^{n} \frac{O_i(1-t)}{(1+K_t)^i} - \frac{V_n}{(1+K_t)^n} - \frac{t_c A_o}{1+K_t}$$

This method assumes that the firm's objective is to maximize its wealth and takes into consideration the lease-loan decision. Again, K_t is a weighted average cost of capital for the firm and the rate of return that a firm's investors expect. K_t also can be applied to basic cash flows associated with leasing to discover how the market value of the firm will be affected by the lease choice. Thus, the operating advantage of the lease can be measured. The non-cancellable claims included in the lease agreement can be capitalized at the rate that applies to debt. This rate is designated r and is used to determine the market value of the lease. Thus, the financial advantage of the lease is the difference between the market value of the lease and the loan that could replace that lease.

The model takes the rates K_t and r as well as the optimal mix of debt and equity and relates them all to the risk in the firm's flows. According to the authors, the proper assumption is that a lease payment schedule of any configuration can be matched by a loan or series of loans with the same configuration. Thus, we adjsut for our uncertainty by adjusting K_t and r.

Also, of note is the fact that I_i'' is calculated as follows for this model.

$$I_i'' = X_{i-1}\, r$$

where

X = purchase price of the loan.

$$X_{i-2} - (B_{(i-1)} - V_{(i-2)}r) \quad \text{for } i = 2 \text{ to } i = n$$

where B are the loan payments that are equivalent to the lease payments.

$$B_i = R_i\left(\frac{X_o}{E_o}\right)$$

where E is the market value of the lease.

$$E_o = \sum_{i=1}^{n} \frac{R_i}{(1+r)^i}$$

The market value of the lease is defined as the sum of the lease payments discounted at the loan rate. The market value of the alternative loan is equal to the purchase price of the equipment that the loan would finance.[4]

The final decision will dictate that we lease if the NAL is positive and buy if the NAL is negative.

Annual Installment Model

The last model to be considered is the Annual Installment model.

$$NAL = \sum_{i=1}^{n} \frac{L_i}{(1+r_t)^i} - \sum_{i=1}^{n} \frac{R_i}{(1+r_t)^i} - \sum_{i=1}^{n} \frac{tD_i}{(1+r_t)^i} + \sum_{i=1}^{n} \frac{tR_i}{(1+r_t)^i}$$

$$- \sum_{i=1}^{n} \frac{tI_i}{(1+r_t)^i} + \sum_{i=1}^{n} \frac{O_i(1-t)}{(1+r_t)^i} - \frac{V_n}{(1+K_t)^n} - \frac{t_c A_o}{1+r_t}$$

This model also takes into account the burden of financing a purchase if buy is the final decision in the lease versus buy decision. The first term on the right hand side of the equation differs from the first term of the right hand side of the equation in the Lump Sum Loan model in that the former assumes annual installments repaid whereas the latter considers a lump sum loan purchase in the first year. The rest of the equation's elements are fairly straight forward except for the following two points. Note first of all that I_i is computed directly from the loan payment for period i instead of the more complicated method in the Bower, Herringer, and Williamson model. Note also that all elements, except salvage value considerations, in the Annual Installment model are discounted to the firm's after-tax debt rather than the after-tax weighted average cost of capital for the firm which appears in the Lump Sum Loan

model and the conventional NPV model. According to Weston and Brigham, in comparing two financial alternatives there is essentially no risk to the firm in obtaining the savings attributable to one alternative over the other. If this be the case, then, a discount rate that reflects the low risk is preferable to one that reflects the firm's average risk.[5]

A positive NAL result indicates that it is cheaper to lease rather than buy, and a negative result indicates that it is cheaper for the firm to borrow and purchase rather than to lease.

Survey Findings

a. The survey found that seventy percent of the firms used the IRR model and the NPV model.

b. The remaining survey respondents admitted to using variations of the Weston and Brigham model and the Bower, Herringer, and Williamson model.

FOOTNOTES TO CHAPTER IV

[1]Anderson, Paul F. and Martin, John D., "Lease Versus Purchase Decisions: A Survey of Current Practice", Financial Management (Spring, 1977), pp. 41-47.

[2]Ibid.

[3]Levy, Haim and Sarnat, Marshall, Investment and Portfolio Analysis, 1972, pp. 73-79.

[4]Bower, Richard S., Herringer, Frank C., and Williamson, J. Peter, "Lease Evaluation", The Accounting Review, (April 1966), pp. 257-265.

[5]Weston, J. Fred and Brigham, Eugene F., Essentials of Managerial Finance, 1968, pp. 264-273.

[6]Anderson, Op. Cit.

V. PAYBACK ANALYSIS

Some organizations use payback analysis in their everyday lease versus buy decisions. The following discussion of this much maligned method is undertaken as a basic building block to the understanding of the lease versus buy subject.

The payback period is defined as a measure of the time it will take to recover the original investment from the resultant improvement in cash flows from earnings or savings. Firms that use this method establish a minimum acceptable payback period, e.g., such as a three year period. This period would then be the accept-reject criterion. If a firm then determined that an initial investment on a project will be recovered sometime in the fourth year of the project's life, the proposed project would fail to meet the established test.

Obviously, then, what this criterion does is favor those projects which return the largest benefits in the early years relative to the initial outlay. This result is desirable; however, weaknesses occur because this method fails to discriminate as to the timing of the cash flows and fails to account for the benefits which lie beyond the payback period. Thus, the payback criterion is not in fact a true measure of profitability.

Although payback analysis has declined relative to time-adjusted methods in capital budgeting, this method is still widely used in both industry and government. Familiarity, simplicity, and apparent objectivity are reasons for this consideration. Although the aforementioned criticisms do exist, they are diminished in importance if the comparisons of alternatives are among a family of investment opportunities having roughly the same economic life and profile of benefits. Thus, there is a rough similarity with the true profitability established in the time-adjusted method in that both methods favor high cash flows in the early years. However, it is not wise to assume that a firm would accept an investment proposal that promised to return solely the initial investment. Thus, in practice a firm using the payback criterion would probably make a qualitative rather than quantitative decision regarding the cash flow in the years following the payback cutoff.[1]

Of further interest to the firm that is making capital budgeting decisions is the fact that the payback period can under certain circumstances provide a rough estimate of the investment proposal's rate of profit. Note, from our definition of the payback period, that the reciprocal of the payback period (K = 1/payback period) is the reciprocal estimate of the rate of profit. Therefore,

$$K = \frac{1}{\text{payback period}} = \frac{S_t}{C}$$

where

k = the proposal's expected rate of profit.

S_t = the earnings or savings before depreciation that the proposal is expected to provide in the year t.

C = the cost of the proposal.

n = the number of years the equipment is expected to last.

Then from our net present value formula,

$$C = \frac{S}{K} - \frac{S}{K}\left(\frac{1}{1+K}\right)^n$$

where salvage value is assumed to be negligible, our rate of profit is

$$K = \frac{S}{C} - \frac{S}{C}\left(\frac{1}{1+K}\right)^n$$

From the above equation, the second term approaches zero as n, the life of the proposal, becomes infinitely large. The above results yield the following conclusions.

a. If an equipment proposal will earn or save the same annual amount forever, its rate of profit is simply the reciprocal of its payback period.

b. If the equipment will last a finite number of years, the rate of profit is at most the reciprocal of the payback period and smaller by the quantity $S/C(1+k)^n$.

Myron J. Gordon developed the above reasoning. Gordon also determined that the project life which yields extremely small errors between the true rate of profit and the payback reciprocal estimate of the rate of profit is two or three years greater than twice the payback period in a before tax situation. Further study also indicated that in regards to tax and depreciation considerations, the payback reciprocal estimate is a good estimate of the true rate of profitability for a project life above the post tax payback period.[2]

After all the above factors have been considered, the final justification for using payback analysis probably lies in the realm of risk reduction rather than just profitability analysis. Many firms have little faith in mid-term and longer projections of the future. The payback analysis is in essence a crude measure of risk. If a firm has little confidence in demand forecasts, capital expenditure program projections, etc., there will be a natural inclination to measure the time it will take for an investment to return the original outlay in relation to some near-term payback criterion. Thus, indeed, the payback standard can be considered as a rough measure of the level of confident judgment.[3]

FOOTNOTES TO CHAPTER V

[1]Hunt, Pearson, Williams, Charles M., and Donaldson, Gordon, Basic Business Finance, 1971, pp. 173-176.

[2]Gordon, Myron J., "The Payoff Period and the Rate of Profit," The Management of Corporate Capital, Ezra Solomon, ed., 1959, pp. 48-55.

[3]Hunt, Op. Cit., p. 176.

VI. TERMINAL VALUES

The lease is a contract which separates the possibility to use the property from its ownership for the period of the lease. The contract dictates that at the expiration of the lease, the property is returned to the lessor together with all permanent improvements installed by the lessee. One argument favoring ownership over leasing that is frequently heard is that the values that will exist at the end of a lease contract are too great to surrender. For example, real estate is a certain type of property that usually enjoys a high sale value at the time the lease expires and, consequently, it may be desirable to hold title for the purpose of gaining from this residual value. However, we must take into consideration the fact that money which may be received in the distant future has far less value in the present than its future amount makes it seem to have.[1]

In everyday practice, though, the possibility of substantial end of life capital value is frequently overlooked by decision makers in the lease versus buy appraisal. The following factors probably can be attributed to this omission.

a. Economic life is frequently so long and ultimate dollar realization so far distant that these future values have very little effect on present investment decisions.

b. The probable residual is sometimes so low that it can safely be ignored.

c. The available data on the asset to be considered for use does not provide an adequate base for forecasting.

d. The future is so uncertain that changing conditions may wipe out whatever values seem probable once the economic decision has been made.

Residual values or terminal values have more meaning than the term salvage value implies. Terminal values include everything that produces or retains a cash or opportunity cost value at the time the physical facilities contemplated in the lease versus buy proposal are retired or replaced. The value is usually positive in amount but sometimes may be negative.

Some items in which terminal values play a significant role are, as mentioned above, real estate whereby lease-back arrangements often carry relatively low interest charges, partly because the lessor forecasts an increase in the value of the land included in the lease-back package. Also of importance in lease versus buy decisions are resale values of used buildings and machinery which is thought of more conventionally as salvage value. Another source of value that is sometimes overlooked, usually because its original cost is occasionally not included in the initial investment outlay, is the firm's investment in working capital (e.g., inventories, receivables, etc.). Peculiarities

of the tax laws can be a source of residual value that must be taken into account in a lease versus buy decision. Capital losses can be taken for tax purposes when a piece of equipment or a building is sold or scrapped before the end of its IRS approved write-off period. Thus, capital losses for tax purposes can produce tax credits that are just as much a part of a project's cash flow as are the direct proceeds from the sale of the facilities themselves. From the above samples, the correct conclusion is that what matters in regards to terminal value for the lease versus buy decision is the case value at the end of the asset's economic life. However, if the terminal value does indeed not influence materially the investment worth of a capital decision, there is no practical gain to be had for measuring that value.[2]

In an article entitled "Residual Values in Investment Analysis" by Gordon Shillinglaw appearing in Ezra Solomon's The Management of Corporate Capital, the following propositions were proposed regarding terminal value, economic life, tax life, and/or annual earnings.[3]

a. If the tax writeoff is in line with the life time decline in the resale value of the original investment, residual values have little effect on rate of return.

b. If these two variables are not in line, residual values can have a major influence on the investment decision, provided that economic life is short and/or the minimum cutoff rate is low.

c. When economic life is long (e.g., ten years or longer) and the company's minimum cutoff rate is high (e.g., 20 percent or higher), the effect of the residual value on the investment decision is likely to be limited to borderline projects.

d. When economic life is short and/or when the minimum cutoff rate is low, residual values will have a broader range of influence, and estimates should be made.

e. When the minimum cutoff rate is high and economic life is long, the rate and level of the tax writeoff has a far greater impact on investment worth than is made by residual value.

From the above mentioned points, it behooves the lease contracting parties to write their contracts with a decision that examines an allowance for a terminal value which could alter the required lease payments in favor of the lessee. Thus, careful negotiations of the terms of a lease can overcome the disadvantage of loss of title, unless major capital gains are very certain.

Estimating terminal values is a very difficult task, but if terminal values are deemed influential in the investment decision, the task must be addressed. The most frequent excuse in disregarding terminal value is that adequate data is not available. It is true that many firms do not have routine reporting systems in which a flow of data is in a readily usable form. Also of consideration is the fact that many estimates can not be based completely

on data that is produced as a by-product of the normal historical record of transactions. However, estimates should be made although it is generally understood that precision will not be achieved. To be remembered here is that great precision is not necessary because fairly substantial error ranges in the estimates of terminal values can be tolerated because of the effect of time on present value in our lease versus buy decision.

Although historical data can be used, the decision maker must be forward-looking. The relevance to the future must be evaluated. Past accounting records are generally most useful in estimating the resale values of plant and equipment. For example, each piece of equipment gives rise to a set of information relative to resale price and removal. Thus, this type flow of information can be systematized to lay the foundation for future estimates. Of interest to the decision maker are firm and quasi public sources which specialize in surveys of asset terminal values. In some cases terminal value curves can be derived from some of the currently available published special surveys.

Before closing this chapter, it is prudent to address one further argument that is advanced as a justification for ignoring or sharply discounting future residual values. This argument states that conservatism dictates that the future is so difficult to predict that the prudent investor should assume the worst possible scenario, that is, assume

terminal value to be zero. To counter this argument, we must remember that a policy of ignoring terminal value is not truly a conservative policy. Instead, a conservative policy should attempt to maintain and increase the value of the firm. An objective appraisal of risks and a willingness to go forward is necessary when opportunities for gains outweigh risk of loss. Ignoring terminal value in the lease versus buy decision may falsely help determine the ultimate decision.[4]

FOOTNOTES TO CHAPTER VI

[1]Hunt, Pearson, Williams, Charles M., and Donaldson, Gordon, Basic Business Finance, 1971, p. 426.

[2]Shillinglaw, Gordon, "Residual Values in Investment Analysis," Solomon, Ezra, editor, The Management of Corporate Capital, 1959, pp. 259-268.

[3]Ibid.

[4]Ibid.

VII. UNCERTAINTY ANALYSIS

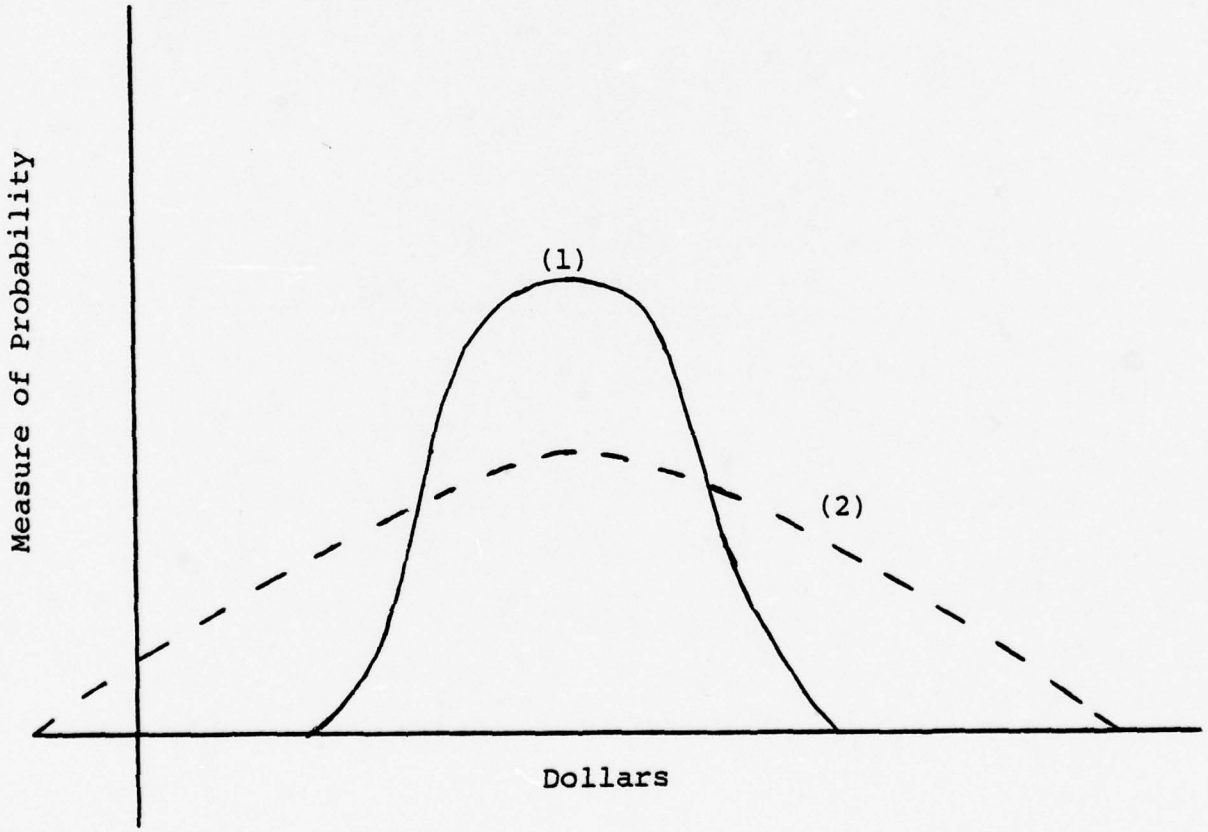
In the lease versus buy decision, there are, perhaps, many possible outcomes. Business uncertainty or risk links the investment of capital in a project with the hope of profit or the possibility of loss. There would be in any investment decision a range of possible outcomes. Examining the characteristics of this range introduces the dimension of risk.

For example a decision maker in estimating the costs or benefits of a cash flow for a particular period would establish a mean or average outcome of that cash flow. He would also establish an upper and lower limit to his most probable value. Curve probabilities could then be charted in some sort of distribution - most likely some type of normal distribution. (See Figure 7-1.) The difference between curve one and two is that the latter is more risky than the former in that the cash flow varies over a greater range. However, both curves reflect the same expected value. This value is the mean of each outcome weighted by its probability of outcome.

From the above one notes that an investment decision should require a central tendency as well as a distribution of other possible outcomes. Statistics can provide the decision maker with a measure of that distribution with the standard deviation. This measure, though, can only be

Figure 7-1

Typical Curves of Probabilities[1]



calculated if we have adequate data for the analysis, and the outcomes are distributed normally. The standard deviation, thus can produce a number that gives a range around the mean within which a certain percentage of the outcomes will fall. The higher the standard deviation, the wider the range necessary to obtain the desired percentage of observations and, thus, the higher the risk.

If one then wishes to compare alternatives and since the standard deviation is expressed in an absolute number, convert the standard deviation into a relative number by dividing the standard deviation by the mean to which it is related. This is called the coefficient of variation.

Although the above would indicate a relatively straight forward method of determining the riskiness of a project that is available, real life situations complicate the process. The statistics become very complex when dealing with a time series of related outcomes and a consideration of interrelated investments. This statistical expertise will probably not be necessary for our eventual methodology as will be explained later.[1]

However, if one were to persevere in his analysis using these statistical methods, the biggest problem would probably occur in the data base for the calculations. Few businesses have the historical cost-revenue relationships with which the distributions could be built. The highly competitive environment prevents the accumulation of repetitive experiences necessary for the analysis.

Hunt, Williams, and Donaldson's Basic Business Finance state two solutions to the above problem. One solution is to substitute judgmental probabilities for historical probabilities. A Delphi technique is conducted with the resultant probabilities used to build a probability distribution. The problems with this method is that although a decision maker may be comfortable with a higher and lower bound to an outcome, the intervening points may remain unconvincing to him. Even if we assume normality in our distribution, refined application on risk may be unwarranted if

a. the investment decision in question is of major consequence and the risk and return differences are small.

b. the risk and return differences are large, a full description of the probability curve may be unnecessary.

The second solution is the use of a computer model of the variable to simulate the environment. The resulting data could be used to build probability distributions in order to compare risk. The major problem is the large amount of time and money necessary to conduct such a program. At present only a few large companies are working on this application. Until computer assisted financial analysis becomes widespread, decision makers will probably use rough yet easier approaches.

In everyday practice businesses give no explicit account for risk in their capital budgeting decisions. However, if differences were substantial and apparent, a subjective

analysis is done. Most firms use a cost of capital rate or discount rate to reflect not only their cost of debt and equity but also their risk level of the business. Also of note is the fact that if a risk level of a particular project is different from the norm, an adjustment to the hurdle rate is made, often, as stated above, subjectively.

Some firms use multiple hurdle rates reflecting different risk categories. In a multidivision firm, each division would have a different hurdle rate depending on the risk level of that division. The same rationale can be used among the different product lines of a multiproduct firm. Each product represents a different risk level and is reflected as such by a different hurdle rate. However, a key point to be made from the above is that the decision maker should not use a different hurdle rate just for one element of a product line, division, market area, etc., but that the decision should encompass a careful risk analysis of the financial changes resulting from major strategic choices in the use of corporate resources.[2]

The application of a single risk adjusted discount rate to all individual projects in the firm is, as implied before, widely accepted by private firms although theoretically weak. The key assumption here is that the characteristics of the individual projects do not change the average risk level of the firm. However, in the case of a firm which must choose among investment opportunities with inherent

risks that do change the average risk level of the firm, Haim Levy's and Marshall Sarnat's Investment and Portfolio Analysis suggest the following procedure:

> a. In the first stage the future cash flows of all projects are reduced to a common denominator by calculating their present values ... The appropriate discount rate is the riskless rate of interest.
> b. After adjusting for the time value of money, the estimated "market price" of a unit risk is used to find the optimal combination.[3]

A government project's risk or procurement strategy's risk, such as lease versus buy, is similar to a firm's risk. Examples here would be weapons systems that do not work as predicted and canals that become abandoned before anticipated. Thus, one could not say that a government project with a return on investment of nine percent should be equal to a private firm's rate of return of, say, fifteen percent on a similar project because of implied differences in the risk allowances of the participants. However, several economists have argued that because the government takes on so many investment projects in the economy, these projects incur no risk on the principle of the law of large numbers. This method is the same principle that a life insurance company works upon when the company does not know when an individually insured policy-holder will die. This last premise seems logical and very workable in an approach toward risk in the lease versus buy decision methodology for the Army.[4]

FOOTNOTES TO CHAPTER VII

[1]This part of the discussion is taken from Pearson Hunt, Charles M. Williams, and Gordon Donaldson, Basic Business Finance, (4th ed.; Homewood, Ill.: Richard D. Irwin, Inc., 1971), pp. 176-178. The above authors recommended that a very theoretical discussion of the statistical methods involved in the analysis can be found in J. Fred Weston and Eugene F. Brigham, Managerial Finance (3d ed.; New York: Holt, Rinehart and Winston, Inc., 1969), chap. VIII; or James C. Van Horne, Financial Management and Policy (Englewood Cliffs, N.J.: Prentice-Hall, Inc., 1968), chapter IV and V.

[2]Hunt, Pearson, Williams, Charles M., and Donaldson, Gordon, Basic Business Finance, 1971, pp. 178-182.

[3]Levy, Haim and Sarnat, Marshall, Investment and Portfolio Analysis, 1972, p. 521.

[4]From a footnote appearing in Baumol, William J., "On the Appropriate Discount Rate for Evaluation of Public Projects," in a statement from The Planning-Programming-Budgeting System: Progress and Potentials (Hearings before the Subcommittee on Economy in Government of the Joint Economic Committee, Congress of the United States, 90th Congress, 1st Session, U.S. Government Printing Office, Washington, D.C. 1967).

VIII. TWO GENERAL EXAMPLES OF THE LEASE VERSUS BUY DECISION IN INDUSTRY AND GOVERNMENT

The purpose of this chapter is to discuss the lease versus buy decisions for two major transactions, one from industry and one from government. The proponent's arguments as to the transaction assumptions will be set forth to demonstrate the elements of the final decision and to give the reader an insight into the actual application of the previous chapters' discussions in the lease versus buy decision.

The first case concerns Anaconda Company's lease of an aluminum mill in 1973. Anaconda built the mill and then negotiated a lease through U.S. Leasing International. The 1971 Chilean mines' seizure by the Allende Government created a tax loss of nearly $360 million. Therefore, if Anaconda had chosen to own the plant, the investment tax credit and the depreciation tax advantage would have been of no immediate value. The salvage value was perceived to be negligible after an assumed twenty year period life span. In calculating the value of lease over purchase, the most difficult task was to find the right discount rate. Since this lease was a leveraged one, i.e., part of the $110.7 million for the cost of the plant was raised from three insurance companies to a total of $72 million, 9.125 percent was negotiated with the insurance companies for their contribution. This value

was then assumed by Anaconda to be its cost of capital and used as its hurdle rate after assuring itself that this would have been the rate the company would have had to pay to completely finance the plant by bonds. On a semi-annual basis, the rate is 4.56 percent. Over a twenty year life with the extreme assumption that no taxes would have to be paid for the next twenty years, the only liability created by the lease contract would be the present value of the lease payments themselves, $84.792 million. The present value to Anaconda is then $110.7 - $84.8 = $25.9 million. The effective rate on the lease was 5.542 percent.[1]

Forgotten, of course, in the above Anaconda analysis is the fact that some of the depreciation tax shields could have been carried forward and eventually used if Anaconda had bought the plant. On the other hand, once Anaconda starts paying taxes, the cash outlay for lease payments declines by half. However, Anaconda probably forsaw this possibility in that the first twentyone payments were $3,985,034 each and the last nineteen were $5,460,278 each. Even with the above items taken into consideration, Anaconda made a substantial net present value gain given the reasonable forecasts made at the time of the contract.[2]

The above example was a classical case whereby a company perceived that by leasing, it would be able to pass on the tax benefits it could not use. A lessor who could use the tax benefits would in turn give a good deal on the lease

rate which could terminate in an interest rate well below the company's long term rate. The risk to Anaconda is that the company could become profitable earlier than predicted. The lease decision could then prove to be the more expensive decision and, consequently, the company could be locked into an uneconomic deal for a long time.[3,4]

The second case concerned the Navy's leasing of transport ships in 1974 rather than buying these ships outright. The lease, or charter, extended over a period of twenty years in which payments from the government to the investors occur annually. In essence the government signed a contract stating that the government would lease a ship that a shipyard built. This government obligation is used by the contractor to secure short-term funds for construction. Once the contractor delivered the ship to the Navy, long-term financing was substituted for the short-term construction loans. These loans are usually through the sale of bonds to institutional lenders, leasing companies, and commercial banks.[5]

The Navy contended that the build and lease program was less expensive than outright purchase because the cash outflows were discounted based on the government's ten percent present value of money. The lease was properly structured so that a greater proportion of cash was paid during the earlier years. The Navy then calculated that the combined effect of the lease option was to yield an effective interest rate of 5.961 percent. This value compared

favorably with a twentyfive year bond issued by the Treasury at seven percent. The advantage to the owners in this transaction was the use of the accelerated depreciation range of a ship using either double declining balance or sum of digits method. These methods resulted in large amounts of depreciation against other income. The tax deferrals were set aside in a sinking fund and invested until it is time to pay the deferred taxes. The lease companies and banks also are repaid their investment plus a fixed rate of return on that investment. The bondholders received payment of their bonds plus the agreed upon rate of interest. Finally, the shipbuilder made his profit on the actual construction of the ship.[6,4]

The specific advantages of lease in this case are the following.

> a. By proper structuring the charter hire to defer the bulk of the payments as long as possible, there is a substantial economic saving to the government.
> b. It enables the Government to secure the use of new ships on credit and without any large outlay of funds.
> c. The Government does not pay any charter hire until the ship is ready for use.
> d. It spreads the cost of the ship over the life of the ship.
> e. The financial restrictions and the use of a fixed price ship construction contract eliminate cost overruns and inhibit contract changes.[7]

FOOTNOTES TO CHAPTER VIII

[1]Myers, Stewart C., Dill, David A., and Bautista, Alberto J., "Valuation of Financial Lease Contracts," (June 1976), pp. 808-809.

[2]Ibid.

[3]Vanderwicken, Peter, "The Powerful Logic of the Leasing Boom," Fortune, (November 1973), pp. 132-138.

[4]Both the Anaconda case and the MSG charter case have generated controversy as to their ultimate decisions. For other interpretations, see Valuation of Financial Lease Contracts by Stewart C. Myers, David A. Dill, and Alberto J. Bautista, Journal of Finance, June 1976, pp. 799-819, and Who Should Own the Fleet by Michael Block, 1975, Memo prepared for CNO at Naval Postgraduate School.

[5]GAO Report to The Congress, "Build and Charter Program for Nine Tanker Ships," August 15, 1973, pp. 1-33.

[6]Ibid.

[7]Ibid., p. 27.

IX. CURRENT LEASE VERSUS BUY POLICY FOR THE PROCUREMENT OF OFFICE COPYING EQUIPMENT

The Army sets forth its policy in regards to the purchase of office copying equipment through several sets of regulations. These regulations specify the criteria that a using agency must utilize in making the operational and financial decision as to whether to procure an office copier. Because the operational decision would be of no consequence in the lease versus buy decision, the following discusses only the financial aspects of the transaction assuming that an army agency decided it needed a copier.

Department of the Army Technical Bulletin, TB AG 4, Office Copying Equipment, states that in the rental versus purchase decision, the decision maker is to amortize purchased equipment within two years. This result would then show benefits of a year or two more. The assumption here is that an office copier would last no more than four years from date of the procurement. The following simplified formula is suggested.

> a. Subtract the monthly maintenance contract cost from the monthly rental.
> b. Divide the remainder into the purchase price of the machine. The answer is the number of months it will take for the purchase price to equal the amount which would be spent for rental. At this point, the machine can be said to have been paid for, and the copy cost would thereafter be limited to the cost of supplies and maintenance.[1]

United States Forces Command (FORSCOM) and United States Training and Doctrine Command (TRADOC) have each issued current supplements to regulations on copier procurement policies to their respective commands. The TRADOC supplement specifically says that "Purchase of copiers will be restricted to those instances where break-even/payback period can be realized in five years or less ... ."[2] The FORSCOM supplement says essentially the same thing with the following addition.

> If funds are not available for purchase, it is recommended that purchase be programmed for the next fiscal year and rent the copier for the remainder of the current fiscal year. When funds become available, apply the "option to purchase" terms towards reducing the original purchase price.[3]

Interviews were conducted at Fort Ord, California to observe the actual implementation of the aforementioned directives. The person in charge of procurement at Fort Ord relied upon the financial analysis done by the highest headquarters of the user agency, either TRADOC or FORSCOM. The FORSCOM decision maker made his lease versus buy decision based solely on the cash flow which yielded the smallest monthly cost over a five year period. In reality this method was a payback analysis in which depreciation was considered a monthly "charge". This individual was rewarded on the cents per copy criteria in that the smaller this figure the better his rating. Thus, if a purchased machine was fully depreciated after a five year period and was still operational (which was usually the case), the overall cents per copy cost would be very small. In summary, then, the

decision was first to choose the copier make and model by lowest purchase price and, separately, decide whether to purchase or least it.

The decision maker at the TRADOC agency at Fort Ord followed the payback criteria provided by the regulation. Of note is that his justification to the commander also would involve a net present value criteria to justify whether a chosen machine would be financed by a lease or purchase transaction. The decision maker preferred the payback criteria in that he found that a non-financial oriented commander was more attuned to a payback criteria than a NPV criteria. Again, in any case, the decision as to which copier was to be selected depended upon the purchase price with the decision to lease or purchase a separate step. The lease versus buy decision was also heavily influenced by the amount of money available for the fiscal year in that if a machine was perceived to be needed and funds were short for the year, a lease would be established with a later option to purchase in the following year. The financial advantages of this type of transaction are never analyzed as to type of machine to procure and to the extra cost, if any, that would be involved over a straight purchase.[5]

All prices for copying equipment and related services are standardized by the General Services Administration Federal Supply Schedule Price List. These prices are negotiated by a centralized contract that covers all equipment that a vendor offers for sale in a given year. These prices

are then used by procurement officers at major installations to decide what machinery to procure and whether lease versus buy is in their best interest. Note that if the prices have already been negotiated as to lease costs and purchase costs, the decision has already been made whether a using unit should lease or purchase, assuming ample fiscal year funds are available, based on the regulations' use of the payback criteria.

FOOTNOTES TO CHAPTER IX

[1]Department of the Army Technical Bulletin, TB AG 4, Office Copying Equipment, November 1968, p. 13.

[2]Department of the Army, "TRADOC Supplement 1 to AR 340-20", p. 2.

[3]Department of the Army, "FORSCOM Supplement 1 to AR 340-20", p. A-1.

[4]Interview conducted with chief of procurement, Fort Ord, California, 28 September 1978.

[5]Interview conducted with financial management officer CDEC, Fort Ord, California, 29 September 1978.

X. PROPOSED METHODOLOGY

The following is a general description of a lease versus buy methodology of a system using the procurement of an office copier by the Army as a vehicle for demonstration. Of course, this proposed method could be used for any number of systems in which the Army has a choice of lease or buy.

The analysis of need for a system should involve the normal operational analysis as to its increase in efficiency versus cost in the organization. The final choices should include, as examples,

a. do nothing
b. purchase system A
c. lease system A
d. purchase system B
e. lease system B
f. etc.

for every how-many choices are available to the decision maker. These final choices should be screened only as to regulations involving environmental constraints such as Buy American legislation, availability of maintenance, etc. Assume also that the decision maker would consider only alternatives that closely met his needs. This latter assumption implies that he would not wish to consider a larger capability than he anticipated and, thus, unduly compare a

larger yet costlier system with a smaller yet cheaper system that met his needs. In essence the decision making process is a combined one in which all aspects of cost including the method of financing is done in one single step. This approach is contrary to the present method (as outlined in chapter IX in the example of a copier) of choosing a system first and determining the finance arrangements second. Instead, all costs should be outlined and summed for each alternative. The lowest cost would be the optimal choice.

The lease versus buy model that best contributes to the above process is the Bower, Herringer, and Williamson model. (See chapter IV.) This method takes into consideration the lease-loan decision. Because the government does not pay taxes, the third, fourth, and fifth terms are always zero. Also, the Army does not concern itself with the investment tax credit. Thus, the eighth term is zero. The copiers that the Army uses have negligible terminal value and thus, the seventh term can be considered zero for the copier example.

A_0, the first term, is the total purchase price of the system. The second term, $\sum_{i=1}^{n} R_i/(1+r)^i$, is the sum of the discounted lease payments. The r value to which the lease payments are discounted represents the interest rate on the non-cancellable claims that apply to debt. The best estimate of this value would then be the long-term treasury bond rate, currently eight percent. r should represent the riskless rate because the funds are used to finance government

projects as explained in chapter VII. The sixth term, $\sum_{i=1}^{n} \frac{O_i(1-t)}{(1+K_t)^i}$, is the discounted operational payments if the purchase decision is made. This term reduces to $\sum_{i=1}^{n} O_i/(1+K_t)^i$ because the tax rate, t, is considered zero. The discount rate, K_t, represents a weighted average cost of capital for government. This figure measures the operating advantage of the lease compared to a rate of return at which taxpayers could use these funds. As explained in the latter part of chapter four, fifteen percent is probably a good current estimate for this figure. The final formula for the model to the lease versus buy question is as follows.

$$NAL = A_o - \sum_{i=1}^{n} R_i/(1+r)^i + \sum_{i=1}^{n} \frac{O_i(1-t)}{(1+K_t)^i}$$

whereby if NAL is positive, lease is more desirable, and if NAL is negative, purchase is more desirable. Periodically the government should publish the K_t and r rates to be used in lease versus buy decisions in government procurement if the above formula were to be used.

Using just one particular copier, Xerox 3107, as an example to the above explanation, note the difference and magnitude of the NAL values in lease versus buy decisions as the above method is compared with the current payback criteria.[1]

A_0 = original cost + installation - $3\frac{1}{2}$%, 30 days, net thereafter

= \$7885 + \$37 - .035(\$7885 + \$37) = \$7715

R_i = \$205 - .035(\$205) = \$198

O_i = \$65 - .035(\$65) ≈ \$63

Also, subtract a one time charge of \$110 for installation and removal of rental equipment. Note also that a discount of $3\frac{1}{2}$%, 30 days, net thereafter is incorporated into the calculations as specified in the GSA negotiated price list.

The payback criteria in the current regulations yields 57.1 months until the machine is paid off. We would thus purchase rather than lease because 57.1 months is less than the 60 month cutoff specified by regulation. (See figure 10-1.)

Using the Bower, Herringer, and Williamson model for several different conditions yields the results in figure 10-2. As a baseline, calculations show the result when no discounting is used. The ranges for both r and K_t were used to show results for realistic values that would occur in a changing economy. The five year period is demonstrated because of its mention in the current regulations. Interviews indicated that copiers lasted longer than five years. An actual study could quickly be done by a decision maker

Figure 10-1[1]

$R_i - O_i$ = \$198/mo. - \$63/mo. = \$135/mo.

A_0/\$135/mo. = \$7715/\$135/mo. = 57.1 mo.

See chapter IX for detailed explanation of payback criteria for copiers.

Figure 10-2[2]

YEARS	r	K_t	NAL	RESULT
5	0%	0%	\$-495	purchase
5	6%	10%	\$319	lease
5	8%	15%	\$480	lease
5	10%	20%	\$653	lease
8	0%	0%	\$-5355	purchase
8	6%	10%	\$-3337	purchase
8	8%	15%	\$-2922	purchase
8	10%	20%	\$-2483	purchase

to determine the mean lifetime of a copier in a command and use this value as his life span for consideration. Both five and eight year life spans are shown for comparison purposes only. The payback period seems to be a close approximation in this case and would be a rough guide if indeed the Army planned to keep their copiers more than five years. Because this fact is not explicitly stated, the Bower, Herringer, and Williams model, with the stated assumed values, would seem to be a more reasonable method. Also, the payback period method implies a two step decision making process which can not be combined with an overall cost effectiveness analysis to yield a single value for the system.

The resulting NAL value for each candidate system would determine if that system were to be purchased or leased. The cheaper financial arrangement would then be calculated for actual cost inclusion into the cost-benefit analysis of the system. Note that whether lease or buy were chosen for the candidate system, the same assumptions should be applied as they were in the NAL calculation. The result is that when all competing systems are comapred against each other, a one step decision, which already included the financing method, can be determined.

FOOTNOTES TO CHAPTER X

[1]Prices quoted from General Services Administration Federal Supply Schedule Price List for Copy Equipment, Supplies and Services, Purchase of Machines, Accessories, Supplies, Rental, Repair and Maintenance, Xerox Corporation, contract GS-00S-45190 for the period of October 1, 1977 through September 30, 1978.

[2]Present value calcualted using present value of $1/12 received monthly for N years. Using annual tables will yield slightly different results.

XI. CONCLUSION

A lease versus buy methodology for Army procurement in which lease is assumed to be a viable alternative to purchase can be expressed as follows.

1. Assign all recurring costs into operating costs, if the purchase decision were to be made, and lease payments, if the lease decision were to be made.

2. Establish a single purchase price if purchase were to be the final decision in procurement.

3. Establish a realistic salvage value, if applicable, for the end of the anticipated life span.

4. Assume tax payments and the tax credit to be zero for government projects.

5. Use the lump sum model as set forth in chapter X.

6. Discount lease payments to the current long term Treasury bond rate.

7. Discount the terminal value and operating costs to the weighted average of capital for government which represents the operating advantage of the lease compared to a rate of return at which the private sector could use these funds. Currently, fifteen percent is a good figure as explained in chapter IV.

8. Calculate the NAL which will determine whether the lease or buy option is the cheaper method to financing the system.

9. Conduct the overall cost-benefit analysis of the system assuming the cheaper financing alternative is to be used. Insure the same assumptions are applied to this step as they were to the step eight NAL calculation.

10. Make the final decision as to which system to finally procure based on the conventional cost-benefit analysis.

XII. EXTENSIONS

The following is a short summary of areas in the government lease versus buy decision that demand further study.

a. Should a government agency be allowed to lease as an alternative to issuing debt? Private industry considers lease contracts as debt and, as previously mentioned, is so reflected in the firm's annual financial statements. However, each government agency down to local managers of specific government units are allowed to make the lease/purchase decision. They, then, can be considered to be making a debt financing decision. The question is whether or not Congress consciously desires that local managers assume responsibility for taking on new debt by way of leasing - a function normally and explicitly given to Congress.

b. Should the GAO use a different approach wherein each command should be allowed to make its <u>own</u> cost of capital? As noted in the current lease versus buy decisions, the amount of the discount rate plays an important role in the final outcome. Implied in an agency chief deciding one project out ot many with a limited budget is his "gut-feel" discount rate which produces his final decision. This implied rate may not be explicit when the final decision is made but could be computed after the final outcome. The advantage to this approach is that one could say that the chief is the best man to know his own organization and

consequently is the best person to assess its needs. The disadvantages are

(1) that a uniform decision making process is not used and consequently could not be justified to a cost conscious Congress

(2) and that local discount rates do not guarantee the best use of available resources throughout the government.

As seen from the above, both questions are not totally resolved and need further study.

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